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Authentic, Dialogical Knowledge Construction: a Blended and Mobile Teacher Education Programme

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Abstract:

Background: Knowledge construction and technology have been identified as critical for an understanding of the future of teacher education. Knowledge is discovered, applied and created collaboratively from authentic starting points. Today's new mobile and blended learning environments create increased opportunities for such processes, including learner-centred approaches, authenticity and dialogical knowledge construction. However, teaching still requires appropriate learning design and structuring. The presented study explored, and was designed and implemented, using the 'DIANA' (Dialogical Authentic Netlearning Activity) pedagogical model, which is seen as one of the learning designing models for existing digital, open and mobile learning environments.

Purpose: The purpose of this study was to identify the challenges and opportunities inherent in the adoption of the DIANA model and to examine student teachers' reflections concerning authentic and dialogical knowledge construction. The focus is on the learning process.

Sample: Participants were 63 student teachers who were following the study module 'Networks in Vocational Education' at the School of Professional Teacher Education, in Hämeenlinna, Finland.

Design and methods: This qualitative study uses a deductive content analysis to discern relationships between the data and the existing theory. The data for this study was drawn from an online questionnaire and participants' self-reflective accounts.

Findings: The results indicate that achieving deep-oriented learning through dialogical actions is the most challenging part of using the DIANA model. Some of the students had difficulty understanding the concept of 'authenticity'.
Conclusions: The findings of this study suggest enhancing learner-centred scaffolding and guidance, particularly at the outset of the learning process. In addition, methods that develop dialogical skills and competences ought to be integrated into teacher education as extensively as possible, in order to make collaborative work and problem-solving genuinely dialogical and equal.

Keywords: DIANA (Dialogical Authentic Netlearning Activity) model, dialogical knowledge construction, authentic learning, blended learning, mobile learning, teacher education

Introduction

Teacher training, together with higher education in general, faces the challenge of bridging education and work. Teacher education programmes address this issue by adopting learner-centred and collaborative pedagogical approaches. Such routes include inquiry learning, problem-based learning, and project-based learning, all of which capitalize on authentic professional practice and related phenomena, problems, and situations (e.g., Brush and Saye 2014; Hunt 2015). Teacher education is also required to bring itself up-to-date by responding to the current digital, mobile and interactive communication and content creation practices, preferences, and cultures of student teachers, as well as their present and future students.

In this article, we will present a study based on a blended and mobile teacher education study module provided by the Häme University of Applied Sciences, School of Professional Teacher Education, Finland. The purpose of the study is to gain insights that can be used to develop teacher education programmes that better support students' dialogical and equal collaboration and problem-solving with the help of mobile devices. The two primary authors of this article both work as teachers in this programme, which aims to address both of the aforementioned challenges through the use of the DIANA (Dialogical Authentic Netlearning Activity) model in the design of the learning activities. The creators of the model, Helena Aarnio and Jouni Enqvist (2002) point out that taking a dialogical leap is a precondition for deep-oriented and efficient learning in the digital age. Previous studies (Enqvist and Aarnio 2004; Aarnio 2006) have indicated that authentic dialogical learning is difficult in online settings and that the construction of such knowledge should be structured more deeply in the learning processes of teacher education. The DIANA model combines the key factors of learning and teaching in the digital age in an inquiry-oriented practice-based tool and learning framework. At the present time, in many educational settings and systems, becoming a teacher and practising as a teacher require one to work with processes which are, by nature, more communal than ever before: teachers must operate in various learning communities and communities where knowledge is

constructed. Dialogical skills are necessary, so that efforts toward authentic, integrative and interdisciplinary knowledge construction can be successful (Aarnio and Enqvist 2016).

Knowledge and technology have together been identified as critical for an understanding of the future of teacher education. Royle, Stager, and Traxler (2014) challenged the relevance of the existing programmes that fail to make major adaptations as a result of emerging innovations and, in particular, the increased mobility arising from learning that uses mobile technologies. Knowledge is discovered, applied, and created collaboratively, from authentic starting points. The new mobile environments create increased opportunities for such a process, including learner-centred approaches, authenticity, and dialogical collaborative work. However, teaching still requires appropriate learning design and structuring. In addition, the integration of technology into learner-centred and collaborative approaches, such as problem-based, project-based, and inquiry-oriented learning, is challenging for pre-service and practising teachers alike (e.g., Brush and Saye 2014).

According to Glahn's (2016) definition of mobile learning, teacher education should be developed in the direction of "technology-supported learning processes and practices that take advantage of mobility of people and consider learning opportunities that are created by contexts as well as relations and transitions between those contexts" (180). Traxler and Kukulska-Hulme (2016) argued that the next generation of learners in the mobile age is becoming context-aware and that the design of learning will play a significant role in its education. The focal points of the desired type of design are the achievement of a more individualized and flexible style of learning and the enablement of the use of informal learning strategies and environments, situated learning, collaborative knowledge construction, context-aware learning, and learning as a conversation (Bachmair and Pachler 2015).

This paper presents a study that investigated, through qualitative and deductive content analyses, the learning experiences of student teachers who participated in a 'Networks in Vocational Education' study module between 2014 and 2015. The study module was designed using the DIANA model. The following sections introduce the concepts of authentic and dialogical knowledge construction and blended and mobile learning, which form the theoretical basis of our study. Thereafter, the context of the research is presented, together with the research questions and methods. Finally, the results are discussed and suggestions for learning design and future research are presented.

Theoretical background

Authentic and dialogical knowledge construction

In discussions of authentic online learning, many researchers agree that it derives from situated learning (Teräs 2016; Herrington et al. 2009; Aarnio 2006). Most recent studies have indicated that students have difficulty understanding the concept of authenticity, and it is therefore necessary to enhance the pedagogical approach, as well as to improve student-centered scaffolding and guidance (Aarnio 2006; Teräs 2016; Ruhalahti, Korhonen, & Ruokamo 2016).

Designing learning settings that use authentic activities as anchoring assignments can be a difficult process if the previous design was based on a teacher-centred approach (Oliver, Herrington, and Reeves 2006). Shaffer and Resnick (1999) argued that more comprehensive views of authenticity combine learning environments with all aspects of authentic learning; they are personally authentic for the learners, real-world related, provide an opportunity to think in an authentic mode of a particular discipline and assessments include authentic reflections on the learning process itself. Sources and materials are authentic when they are required to understand a topic stemming from a practical approach to solving a problem or creating a product or artefact. This is the case when considered from either individual or group perspectives. According to Aarnio and Enqvist (2016), the idea of authentic learning is viewed too narrowly and the process of finding and creating authentic knowledge by integrating theory into practice has often been designed and implemented without sufficient care.

According to many researchers, learning demands social interaction and knowledge creation is fundamentally a social process (e.g., Vygotsky 1978; Wenger 1998). This is primarily linked to participation and action in communities of practice (Wenger 1998). During the learning process, peers depend on others with more experience, which increases the need for joint participation in learning (Lave and Wenger, 1991). From the perspective of collaborative learning, group members share a goal and contribute new knowledge in order to create a common understanding through interaction. This is achieved by asking questions, evaluating knowledge, and modifying the collaborative approach (see also Dillenbourg 2002). For such activities and interactions to succeed, one must not only be understood, but also understand the viewpoints of others and pay attention to them in order to find a deeper meaning in the dialogue.

Bohm (2004) pointed out that in genuine dialogue, active participation is required. This involves two meanings: i.e. taking part both ‘of’ and ‘in’. Dialogue does not simply mean talking or having a conversation (Bohm 2004; Isaacs 1999); according to Isaacs (1999), dialogue enables a person’s attitudes and self-knowledge to undergo changes, while it also improves our ability to listen and familiarize ourselves with others’ points of view. When collaborating through dialogical actions, it is essential to be equally and consciously present, engaged, listening, participating, and suspending (Bohm 2004).

The research literature on dialogicality in blended and online teacher education and higher education has focused predominantly on dialogical discourse, interaction, and teaching (e.g., Ligorio, Loperfido, and Sansone 2013; Cramp et al. 2015; Sedova, Sedlacek, and Svaricek 2016). However the focus of the present study is on authentic and dialogical knowledge construction specifically on the part of the learning community. In this line of research, several studies have focused on the applicability of pedagogical models that structure the dialogical knowledge construction process online. The results clearly demonstrate that dialogical knowledge construction does not happen by itself, but requires pedagogical modelling and structuring. According to Enqvist and Aarnio (2003), dialogical knowledge construction means that learning is a social process where students, though participation and collaboration, build a shared understanding. This requires the skills of inquiring and questioning, so that the generation of new ideas and knowledge is possible. For example, Bound (2010) developed and instigated the

"Map of Dialogic Inquiry" model to improve online dialogue in the context of adult and vocational education. The results of the case study showed that the model supported and facilitated dialogical inquiry. In British Columbia, Canada, a dialogic learning community model, which emphasized dialogue focusing on real-world problems, was used to instruct adult learners. For the dialogue to be successful, the researchers argue that its characteristics must be featured in the learning model (Guilar and Loring 2008).

Authentic, dialogical online learning and collaboratively constructed professional expertise can be described in a pedagogical model that clarifies the components of learning activities. The study module that the present study explored was designed and implemented using the DIANA model, whose purpose is to create a general view of authentic and dialogical knowledge construction. Table 1 provides an overview of the pedagogical design of the model. The developers of the model (Aarnio and Enqvist, 2016) refer to blended learning and teaching, but the model is equally well-suited to existing digital, open, and mobile learning environments.

Table 1. An overview of the pedagogical design of the DIANA model
Adapted by the authors of the current study from Aarnio & Enqvist 2016, 41–46. Adapted and reproduced with permission.

Cornerstones of the DIANA model	Operative dimensions
A. Creating common ground for the collaborative learning	A1. The idea of dialogical and authentic learning A2. Preparing for dialogical participation in the learning community A3. Structuring and starting collective work
B. Enabling the authenticity in learning	B1. Deriving authentic learning tasks (starting problems) learner-centredly from real life and work situations, formulating problems using language used by students, the starting point being their everyday conceptions B2. Using authentic sources and materials/data to create content and products
C. Increasing deep-oriented learning through dialogical actions	C1. Solving problems and constructing knowledge through dialogical actions C2. Working as equals, participating reciprocally and symmetrically, listening to others, open and constructive inquiry and weaving syntheses C3. The focus is on open, inquiring questions that are used to find solutions and create content
D. Integrating theory and practice in learning situations	D1. Alternating theory and practice, weaving a synthesis, finding gaps in thinking and actions, formulating new problems on the basis of those gaps D2. Continuous reflection and evaluation throughout the learning process – individually and collectively

The revised DIANA model starts from cornerstone A, which creates a common ground for learning collaboratively and dialogically in the learning community. The objective of cornerstone B is to establish authenticity in learning by using problems related to real life and formulating authentic learning questions or assessments. These are connected to the learning objectives of the study module. The teacher's role is to offer scaffolding and guide the students' learning in the right direction. Deep-oriented learning, through specific dialogical actions and collaborative knowledge construction, is at the heart of cornerstone C. In practice, this entails seeking answers to learning questions set earlier, providing individual contributions, clarifying and questioning the meaning of utterances, continuing the utterances of others and participating in the construction of a shared understanding. Cornerstone D integrates theory with practice and requires the students to weave a collaborative synthesis, create shared artefacts and to search collaboratively for new learning questions pertaining to the learning goals of the study module (Aarnio and Enqvist 2016).

Blended and mobile learning in teacher education

As a concept, blended learning is currently being used in learning settings that combine face-to-face and online instruction (Graham 2006; Wagner 2006; Kennedy and Archambault 2012). Blended learning processes combine face-to-face instruction and computer-mediated instruction. Blended learning is seen as one of the more effective pedagogical practices (Graham 2006) and encompasses active learning, peer learning, and student-centered strategies (Morgan 2002). Many researchers agree that technology is not the central concept when it comes to defining mobile learning (cf. Glahn 2016; Sharples, Taylor, and Vavoula 2005; Traxler 2007). Bachmair and Pachler (2015) indicated that mobile learning is morphing into a new state as a result of the accepted use of tablet devices in schools and the growing amount of practical experience of their application. Mobile learning is a wide-ranging concept which, at its simplest, refers to learning and teaching with the help of mobile devices.

Herrington, Herrington, and Mantei (2009) listed some characteristics that they recommended were incorporated into mobile learning. In their view, the use of mobile learning should be linked to authentic contexts and situations wherein learners are able to be mobile. Time is needed for the exploration of mobile technologies and the blending of mobile and non-mobile approaches. It should be possible to apply mobile learning spontaneously, at any time, and in both individual and collaborative learning. A teacher should employ the students' own mobile devices and use mobile learning to mediate knowledge construction. Mobile technologies have been one of the key facilitators of change.

A key element of mobile learning is openness, meaning that its learning environments are inclusive, easily accessible, and portable. Educational openness also refers to open educational technologies and software, content, and knowledge sharing and construction (Iiyoshi and Kumar 2008). Open social software enables people to collaborate, interact, and create online communities with ease (Özkan and McKenzie 2008). Accordingly, the study presented in this

article offers the suggestion of how to combine blended learning design and open content with open educational technology.

In the context of teacher education, blended and mobile teaching and learning approaches, drawing on inquiry-based learning, have become more common and are attracting a growing level of interest from researchers (see Tomas et al. 2015; Hunt 2015). For example, Hunt (2015) studied a group of 55 pre-service student teachers in New Zealand, who participated in a two-month professional inquiry course that adopted a blended learning approach. She concluded that the inquiry process was "an empowering group experience that models the effective teamwork expected of student teachers in their future employment" (57). Hunt also noted the significant reciprocal learning and peer support experienced by the students. Meanwhile, in Australia, Tomas et al. (2015) investigated whether and how a blended learning design promoted the development of substantive knowledge in science and sustainability education and engaged first-year online pre-service student teachers in active, experiential, and praxis-oriented learning experiences. Interestingly, their findings indicated that "a powerful blended learning design can be achieved by using online affordances to facilitate students' learning in their physical environment" (101). An example of this is experiential activities that students online can undertake themselves, in their local environment, and share through, for example, video blogs, which themselves can become shared artefacts for learning.

Purpose of this study

The purpose of this study was to identify the challenges inherent in the adoption of the DIANA model (Aarnio and Enqvist 2016) and to examine student teachers' reflections concerning authentic and dialogical knowledge construction. The focus is on the learning process. This study has two main research questions:

RQ1) What are the challenges and opportunities of the adoption of the DIANA model for blended and mobile learning, from the perspective of student teachers?

RQ2) How do student teachers reflect on and evaluate authentic and dialogical knowledge construction, based on their mobile learning experiences?

Context and methods

Context of the study

The setting of this research was the study module "Networks in Vocational Education" 4 ECTS credit (European Credit Transfer System) in the Professional Teacher Education programme (duration of 1 to 1–and a half years, 60 ECTS credit) of Häme University of Applied Science, School of Professional Teacher Education. The aim of the module is that the students will be able (1) to build and utilize different national cooperative networks in the field of vocational education and training, (2) to function in international networks, (3) to understand the

administration, financing, and management of an institution of vocational education, and (4) to apply in his or her work plans and documents guiding the activities of such organizations.

The study module design is based on the idea of integrating four elements: authentic learning, dialogical collaboration and collaborative knowledge construction through mobile applications. The contribution of mobile learning to teacher education is that it responds to the current mobile communication practices of student teachers, and to the practices of their present and future students. In addition, mobile learning is in line with authentic professional practices that capitalise on collaboration and networking beyond organisational boundaries.

Application of the DIANA model to the study module

The study module was designed and implemented using the DIANA model. The two primary authors were co-facilitators of the four implementations of the module explored by this study. The main components of the learning environment provided by the facilitators were an open course blog, containing freely accessible educational resources, and open blogs for the study circles. The module was designed so that each collaborative learning application could be accessed via mobile devices. Three of the four module implementations included contact teaching, while the remaining course was solely based on online and mobile learning environments.

As we outlined in the previous section on the theoretical background, the DIANA model is based on four cornerstones and activities therein that promote authentic dialogical learning and collaborative knowledge construction (Aarnio and Enqvist 2016). The model does not follow a step-by-step structure; instead, the various issues summarized in the cornerstones are presented simultaneously (Aarnio 2006, 14).

In the six-week study module, based on blended and mobile learning, the learning process started from Cornerstone A, in which students created a common ground for authentic and dialogical learning (Aarnio and Enqvist 2016). The learners were introduced to the idea of authentic dialogical learning, the learning process, and mobile applications. Both video and face-to-face lectures were used as learning materials. The participants were divided into study circles and expected to create a shared blog to document their learning process. However, the study circles were free to decide on the digital applications they wanted to use to support their dialogical collaborative knowledge construction. The facilitator's role was to ensure that students were progressing in their learning journey and to provide scaffolding with the help of the blog and various other mobile applications.

Cornerstone B deepened the individual and group processes of finding and formulating authentic questions that were connected to the learning objectives of the study module (Aarnio and Enqvist, 2016). Each student individually devised their own authentic question concerning the learning goals of this study module – for example, what are the benefits of a teacher practising networking, from the perspectives of both teacher and student? Thereafter, the students formulated shared authentic questions and categorized them into themes. Both the questions and the themes were published on the blog so that they could direct the work during the following activity. In addition, the students decided on the kind of artefact they would

produce during the learning process. The facilitator's role was to offer scaffolding and guide the learning in the right direction. Cornerstone C offers deep-oriented learning through dialogical actions which take place in conjunction with other students' work and construct knowledge about the subject being studied.

Cornerstone D artefacts included, for example, a self-evaluation questionnaire concerning professional networks. Dialogical evaluation was another aspect of the final cornerstone, which enabled dialogical reflections and helps the development of a new contextual understanding (Aarnio and Enqvist 2016).

Ethical considerations

Ethical approval for the study was governed by The Finnish Advisory Board on Research Integrity (2012) guidelines for educational research. The research followed principles that have been endorsed by the research community, that is, integrity, meticulousness and accuracy in conducting research, and in recording, presenting and evaluating the research results. All data were gathered by the two lead authors, who were familiar with all student teachers and who participated and were well-immersed in the study's setting as long-standing members of staff. Study participants were informed that their data would be used in this study and that participation was entirely voluntary. The anonymity of all individuals participating in the research was ensured and explained on the questionnaire form. All communication related to the study was conducted with honesty and transparency. The research organisation also adheres to good working practices and takes into account all data protection legislation.

Data collection and analysis

The participants of the study were 63 student teachers (43 females and 20 males) in the age range of over 25 years and under 60, who were following the four implementations of the study module "Networks in Vocational Education" between 2014 and 2015 (see Table 2). The data for this study was drawn from an online questionnaire (n = 63). The questionnaire was designed in the light of background theories that illuminate the research questions. These were used to form questions to inquire about phenomena, understanding and experiences during the learning process. The survey included three multiple-choice questions about participants' use of mobile devices and applications, as well as their experiences related to such use. In addition, three open-ended questions were used to inquire into the challenges experienced by the students during the learning process. The students were asked to comment on what cornerstones were most taxing from the point of view of both the study circle as a whole and individually. In addition, the research data included the self-reflective accounts (n = 15) of students enrolled in the third implementation of the study module. For the accounts, the students were asked to answer eight open questions regarding their roles in and contributions to the authentic and dialogically constructed knowledge creation processes. During the final

face-to-face meeting of the study module, students were asked to write a self-reflective evaluation of their learning activities and outcomes. Please see the Appendix for details of the online questionnaire and the guidelines for the self-reflective account.

Table 2. Summary of the module implementation and data collection methods.

Module implementations and timeframes	Implementation 1 03-04/2014	Implementation 2 08-09/2014	Implementation 3 03-04/2015	Implementation 4 09-11/2015
Survey participants (N)	16	16	16	15
Blended learning design	2 x 4 hours of classroom learning, 1 hour of online coaching, independent mobile/online learning	3 x 2 hours of online coaching, independent mobile/online learning	2 x 4 hours of classroom learning, 1 hour of online coaching, independent mobile/online learning	2 x 4 hours of classroom learning, 1 hour of online coaching, independent mobile/online learning
Data collection methods	Online questionnaire	Online questionnaire	Online questionnaire Self-reflective accounts	Online questionnaire

A qualitative and deductive content analysis (Schreier, 2012) was used to discern relationships between the data, the existing theory, and the elements of the DIANA model. The main categories of this analysis were derived from the DIANA model and agreed upon by the two primary authors prior to its commencement. The subcategories were formed on the basis of the research data. The content analysis proceeded with the following steps: (a) reducing the data, (b) regrouping the data, and (c) interpreting and identifying units of meaning and forming conclusions on the basis of the data.

First, the two primary authors read the data independently to obtain an overall picture of the participants' responses. Second, the self-reflective accounts were again read independently several times and important passages in the responses were underlined and coded with respect to the research questions. The data were divided into separate themes and reorganized according to the theoretical arguments regarding the theory and elements of the DIANA model (see Table 3). Words, phrases, and sentences were used when coding the data; the themes were generated deductively as the codes were grouped, sorted, regrouped, and resorted. After completing the individual analyses, the first two authors of this article compared and discussed the coding and arrived at an agreement. The whole study was conducted in Finnish. To be

precise, the data collection and the data analysis were conducted in Finnish, and the results were translated in to English by a first language translator.

Results

The findings of the data analysis are described below, and key themes are discussed, with quotations from the data used illustratively. These quotations have been translated from the original language of the data collection (Finnish) into English. Special attention was given to understanding the real meanings of quotations.

In their responses to the online questionnaire, the participants (n = 63) reported that they used smartphones (n = 53) and tablets (n = 36) to communicate and collaborate with their peers. They also stated that they used the following digital applications on a mobile basis: Blogger (n = 35), Facebook (n = 53), Google Drive (n = 38), and WhatsApp (n = 59).

Table 3. Summary of the results of the data analysis, with examples from the data.

DIANA Cornerstones and associated activities (see Table 1)	**RQ1: Categories indicating challenges of adoption of the DIANA model** (The most challenging cornerstone for a student/study circle)	**RQ2: Coding categories indicating authentic and dialogical knowledge construction for Cornerstones B and C** (Number of items)	**Examples from the data (RQ2)**
A. 'Creating a common ground for collaborative learning'	Beginning the learning process (5/5) Understanding the integration of the entire process (4/0) Incoherence (1/1)		
B. 'Enabling authenticity in learning' B1. Finding competence problems from working life	Formulating authentic questions and synthesis (2/7) Lack of time (1/0) Group work (1/1)	Basics found through the objectives of the study module (1) From personal perspective (4) Knowledge and needs of a professional	*We formed authentic questions by thinking about them together on the basis of the description of the study module.* *Stemmed from practical questions; that is, what does a professional education teacher need to know about a given topic?*

B2. Using sources and creating content	Understanding the task (1/0)	education teacher (3) Through one's experiences, skills, and knowledge (5) Constructing shared knowledge (6) Making inquiries and wondering collaboratively (6) Contributing with one's own skills and knowledge (3) Participation (3) Improving information literacy skills (2)	*We read all of your starting material and every student was inspired by the issues they found personally meaningful.* *We constructed knowledge with the help of practical experiences as well as various information sources.* *I continued from the answers of the other members and contributed with my own skills and knowledge.* *As a member of the group, I participated in searching for information.* *Information literacy skills were improved and we learned to distinguish important information from irrelevant information.*
C. 'Increasing deep-oriented learning through dialogical actions' C1. Dialogical problem-solving in a learning community C2. Dialogical help and support in a learning community	Dialogical approach (5/6) Lack of time (3/5) Dialogical problem-solving (working on a task) (1/3)	Inquiry (3) Dialogue made the learning deep-oriented (4) Together we are more (8) An integrated whole was constructed collaboratively (8) New perspectives (2) Time constraints (1) Listening (2) Symmetrical actions (5) Maintaining dialogue (3) Using open inquiry (8) Listening (3) Active participation (5)	*I asked open questions and weaved syntheses, which made it easier to understand the big picture.* *We gained perspectives from various educational levels and generated good discussions and new information.* *We had no time to examine the topic deeply.* *I listened while others talked about their thoughts.* *We worked very equally and rather symmetrically.* *…to give others a turn. I also focused on listening.*
D. 'Integrating theory and practice in learning situations'	Artefact (7/3) Evaluation (2/1) Other (1/1)		

Challenges of adoption of the DIANA model

The online questionnaire asked the student teachers about the most challenging Cornerstone, both from their personal point of view and that of the study circle as a whole (see Table 3). From both perspectives, the most challenging cornerstone was Cornerstone A, during which students formed an overview of the learning process and orientated themselves to the performance of collaborative and dialogical work. For some students, the instructions provided were inadequate: 'I couldn't quite comprehend the instructions and therefore didn't know what I was supposed to do and how...' From the point of view of individual students, perceiving and understanding the learning process as an integrated whole was considered challenging, while this was never mentioned when considering the matter from the perspective of the study circles. Some of the students reported having had difficulties in achieving an understanding of the concept of authenticity (see also Ruhalahti et al. 2016; Teräs 2016).

For most of the students, Cornerstone B, which aimed to enable authenticity in learning, was the most uncomplicated part of the entire learning process. However, the formulation of authentic questions and weaving a synthesis of the study circle on the basis of those questions was considered difficult on the collective level, while from the individual point of view, authentic questions were formed relatively easily: 'very naturally and easily. The study circle included people who, in one way or another, had encountered the topic in their work.'

A large proportion of coding units were related to Cornerstone C, which included collaborative learning, knowledge construction, and learning through dialogical actions using mobile applications. From the perspectives of both individual students and study circles, dialogical work and operating as equals, reciprocally and symmetrically, were considered particularly problematic by a few students during this stage. On an individual level, knowledge construction based on authenticity was considered straightforward, while on the collaborative plane it was considered difficult to create a shared overview from an authentic starting point. This emphasizes the skills and competences required in dialogical thinking.

With regards to the final Cornerstone, D, the most challenging activity from the individual point of view was the collaborative creation of an artefact: a process wherein theory and practice intertwine. This aspect, however, was not as strongly represented when considered from the perspective of the study circle. This activity is a significant part of the learning process, as its goal is to make learning deep-oriented (Aarnio and Enqvist 2016). However, the students experienced different challenges as individuals and as a part of learning communities. Some participants mentioned that self-evaluation and finding gaps in their thinking were challenging.

Reflections and self-evaluations on authentic and dialogical knowledge construction

The aim of the second research question was to deepen our knowledge of how student teachers reflect on and self-evaluate their authentic and dialogical knowledge construction in a

mobile learning process (Cornerstones B and C). The data consisted of the answers to the online questionnaire and students' self-evaluations.

Students formulated authentic learning tasks (B1) on the basis of their personal work-related experiences and competences. In other words, the learning tasks originated from problems brought by real life and work situations, as this quotation indicates:

> 'First, everyone thought up some questions from their own point of view and then we considered the questions together. The synthesis was influenced by the knowledge and ideas of the members of the study circle and the information we had gathered.'

Most of the students considered it easy to formulate open questions on the basis of the study module's learning goals, as the following quotation indicates: 'Information and questions were constructed as if using building blocks. First everyone provided information about a particular section, then the others asked questions about it.' In addition, the competence requirements of professional teachers were mentioned as items used to formulate open questions.

The next activity of the DIANA model (B2) focused on using authentic sources in the creation of artefacts and content. Drawing on one's own experiences, skills and knowledge was considered important for authentic learning by the participants. When they searched for, used and shared authentic information sources on the blog, a sense of community was widely felt and the participants felt that their knowledge and perspectives expanded. What makes collaborative learning meaningful is the community that, through the skills, knowledge, and responsibility of its members, aims to achieve a certain goal (cf. Lave and Wenger 1991; Wenger 1998).

Most of the students considered that the role of mobile devices and applications in their learning process was crucial. They also reported that such applications were inspiring and user-friendly; in addition, some stated that their information literacy skills had improved considerably through using them effectively. The results revealed that mobile applications brought new, enriching, and empowering aspects to collaborative knowledge construction: 'Despite geographical locations, intimacy and presence were strengthened as we worked together in mobile environments. Communication and dialogue (were) effortless and seamless during the study module, more frequently than normally.' The concept of openness in learning was seen as a crucial component (Özkan and McKenzie 2008; Iyosi and Kumar 2008). The teacher's open blog was clearly seen as a supportive and inclusive element in the students' learning.

Dialogical problem-solving and knowledge construction in a learning community (C1) helped to create a shared and integrated whole through collective understanding. Dialogical approaches and attitudes were regarded by students as factors that deepened the learning process, and learning in study circles was considered to strengthen this tendency. The skills and competences gained by making inquiries were regarded as the most rewarding part of the dialogical actions. Most of the students also felt that they gained new perspectives, thanks to

the various skills and pieces of knowledge shared by the participants of the study circle. As one student reported:

> 'Through dialogue, one learned to think of the topic from different angles that might never have opened up to one otherwise. The knowledge and experiences of the group helped one realise how to use the content in practice when teaching.'

Students constructed knowledge through concrete dialogical activities and thereby engaged in the dialogical progress of work (C2). The core activities were: listening, acting reciprocally, participating symmetrically, and wondering about issues in a constructive way. These are deep dialogical actions (cf. Bohm 2004; Isaacs 1999) and can be interpreted to mean that dialogical skills and competences may be developed through participation in learning communities.

Cornerstone C included dialogical inquiry as a means of problem-solving and content creation (Aarnio & Enqvist 2016). Formulating open questions, active participation, and listening were considered significant sub-skills by the participants (C3). The study circle, where people knew each other and felt safe, created the preconditions for a dialogical approach. As one student reported: 'Fortunately, our study circle has worked together before, so we're not afraid to speak our minds and together we find appropriate solutions. No one needs to feel left out of something.'

Discussion and implications

This study focused on a study module in teacher education that creates opportunities for authentic, dialogical, and collaborative learning experiences while integrating mobile learning technologies with a structured learning design. The results indicate that some of the students had difficulties in achieving an understanding of the concept of authenticity and, therefore, it is important to enhance learner-centred scaffolding and guidance, particularly at the outset of the learning process (see also Aarnio and Enqvist 2016; Ruhalahti et al. 2016; Teräs 2016). In addition, deep-oriented learning through dialogical actions was the most challenging part of using the DIANA model (see also Enqvist and Aarnio 2003). Therefore, methods that develop dialogical skills and competences should, we suggest, be integrated (e.g., Aarnio 2012) into teacher education as extensively as possible, in order to make collaborative work and problem-solving genuinely dialogical and equal.

Sharing one's experiences, skills, and knowledge within the learning community was considered important for authentic learning and expanding one's perspectives by the participants of this study. It is clear that mobile applications brought new and enriching aspects to collaborative knowledge construction. As a pedagogical model, DIANA proved to be demanding for students; a problem that is closely connected to a lack of dialogical competence (Aarnio & Enqvist 2016). Although dialogical work is challenging, when done effectively, we believe, it helps learners to create a shared whole through shared understanding. Inquiry skills

were shown to be the most important dialogical skills and competences, but listening, reciprocity, and symmetrical participation were also considered key.

The piloted study model provides an example of educational openness (Iiyoshi and Kumar 2008) for professional teachers who wish to design, teach, and integrate new open technologies into education, use open content, and transparently construct their knowledge. The results of this study are in line with Aarnio's (2006) findings, which indicated that the learning process requires skilful structuring. In addition, when working with the principles of the DIANA model, teaching in open digital learning environments should be skilfully structured.

Collaborative learning requires a community which, through the skills, knowledge, and responsibility of its members, aims to achieve a certain goal (Lave and Wenger 1991; Wenger 1998). The outcome of the learning process is presented as an artefact and a synthesis of the course themes that have been collaboratively created by the study circle. The results of this study indicate that a sense of community is crucial for the delivery of a shared outcome.

Inevitably, this study does have some limitations related to the researcher's positioning and its potential impact on the research (see Yin 2009). The two primary authors of this study were involved in the design and implementation of the module as well as in the data analysis. Therefore, their assumptions and actions may have influenced the research process, and the results may not be generalizable to other contexts of implementation wherein the researchers did not influence the proceedings so directly (Barab and Squire 2004). The reliability of the study could be enhanced by having someone independent of the study - that is, not working as a course instructor - to analyse the data. In addition, using the students' answers to the questionnaires as a starting point for the collection of further data, through face-to-face or online interviews, would have benefitted this study (see Williams 2005).

The present study deepened our understanding of student teachers' experiences concerning authenticity and dialogical knowledge construction in a learning process. Based on our analysis of the data, this paper argues that such students need to be competent in dialogical activities. Therefore, the sub-skills of such dialogical activities (e.g. Aarnio 2012) should be integrated more deeply into the processes of teacher training, so that they become deep-oriented skills.

Our next step will be to study how to combine the DIANA model as a learning design and scaffolding model when students are using open learning environments during their learning process and where teachers' scaffolding is needed. We agree that the role of teachers is central in promoting a dialogical knowledge construction and learning culture. In the future, members of the teaching profession will increasingly need more flexible information and skills related to the use of information and communication technology, combined with pedagogical knowledge.

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Appendix

Source: created by the authors.
Original instruments in Finnish; translated into English for publication purposes.

The online questionnaire:

1. Which devices did you use during the study module?
__ PC __ Tablet __ Smartphone __ Other
2. It was not only possible to participate in the course solely on a mobile device, but also on a traditional computer. Which apps did you use on your mobile device?
__ Blogger __ WhatsApp __ Google Drive __ Facebook
3. How did the study circle create authentic questions? How did you use those questions to weave the syntheses?
4. Which were the most demanding cornerstones from an individual point of view?
5. Which were the most demanding cornerstones from the study circle point of view?

Guidelines for the self-reflective account:

How do teacher students reflect on and self-evaluate the accomplishment of authentic and dialogical knowledge construction?

- How did I contribute to the work of my study circle?
- What kind of knowledge and skills did I contribute?
- From the perspective of knowledge creation and knowledge construction, how did I encourage dialogical work in the study circle?
- How could I have improved my actions and behaviours to help us achieve our goals?
- How dialogical was the work of the study circle?
- How would I describe the knowledge constructed collaboratively, compared to the authentic learning questions?